ON THE SEASONAL DISTRIBUTION OF SOME QUEENSLAND SPECIES OF *ARCELLA* Ehrenberg.

By C. D. Gillies, M.Sc., Biology Department, University of Queensland.

(Communicated by Dr. T. Harvey Johnston.)

(With four Text-figures).

(1.) General

The Rhizopodan genus *Arcella* Ehrenberg, is represented in the fauna of freshwater pools of Queensland so far investigated, by four well differentiated forms, viz., *A. vulgaris* Ehr., *A. discoides* Ehr., *A. mitrata* Leidy, and *A. artocrea* Leidy. On account of the present condition of Rhizopodan taxonomy, these terms are to be interpreted in this paper as follows:—

A. vulgaris Ehr., small, hemispherical forms in which the test may be either smooth or gibbose.

A. discoides Ehr., flat, disk-like species, with the alveoli of the test very small.

A. mitrata Leidy, test normally polygonal; alveoli conspicuous; pylome with a double invagination.

A. artocrea Leidy: under this appellation is included a number of large forms in which, typically, the basal portion of the test is rim-like. This feature ranges from being well developed to absent, but, in a series, there is no questioning the identity of the latter variant in spite of the loss of the rim. The fundus of the test is hemispherical, and the alveolar markings are conspicuous. These forms may be regarded as the Queensland representatives of the species described by Leidy under this name.

A. dentata Leidy, has not been observed, though it has been searched for. This may be on account of its rare occurrence, for

Leidy [(2) p.177], Kofoid [(1) p.100], and Wailes [(3) p.129], all refer to its scarcity.

In this paper are presented the results of a preliminary inquiry into the seasonal distribution of the four forms met with in Queensland. The various collections examined were preserved in weak formalin, and, for identification and counting, an ocular of medium power, and a 2 3 objective, usually were found sufficient. In this investigation, any *Arcella*-test not containing the organism was rejected.

Data.

(1). Brisbane Botanical Gardens.

These observations, extending from September 29th, 1916, to 29th December, 1917, have been made by the monthly examination of material from a lagoon near the old Bird-House. Gatherings were usually taken about the end of each month, but, on 6th October, 1916, and 12th September, 1917, supplementary material was obtained, and, to avoid as much as possible the introduction of disturbing factors, the collections were made near the northern extremity of the major axis of the lagoon, which is elliptical in shape.

	(a) 29th Sept., 1916.		(b) 6th Oct., 1916.	
	Actual No. counted.	Percentage.	Actual No. counted.	Percentage.
A. vulgaris ...	1	2·5	0	0
A. discoides ...	3	7·5	0	0
A. mitrata ...	2	5	16	16
A. artocrea ...	34	85	84	84
Total ...	40	100	100	100
	(c) 30th Oct., 1916.		(d) 28th Nov., 1916.	
A. vulgaris ...	0	0	0	0
A. discoides ...	1	2	43	86
A. mitrata ...	20	40	7	14
A. artocrea ...	29	58	0	0
Total ...	50	100	50	100

	(e) 28th Dec., 1916.		(f) 30th Jan., 1917.	
	Actual No.	Percentage.	Actual No.	Percentage.
A. vulgaris ...	74	71·85	84	84
A. discoides ...	5	4·85	0	0
A. mitrata ...	20	19·42	13	13
A. artocrea ...	4	3·88	3	3
Total ...	103	100·00	100	100

	(g) 28th Feb., 1917.		(h) 29th March, 1917.	
A. vulgaris ...	37	37	67	67
A. discoides ...	1	1	2	2
A. mitrata ...	8	8	19	19
A. artocrea ...	54	54	12	12
Total ...	100	100	100	100

	(i) 2nd May, 1917.		(j) 31st May, 1917.	
A. vulgaris ...	71	71	77	77
A. discoides ...	4	4	5	5
A. mitrata ...	19	19	10	10
A. artocrea ...	6	6	8	8
Total ...	100	100	100	100

	(k) 23rd June, 1917.		(l) 1st Aug., 1917.	
A. vulgaris ...	41	40·60	31	62
A. discoides ...	0	0	3	6
A. mitrata ...	43	42·57	8	16
A. artocrea ...	17	16·83	8	16
Total ...	101	100·00	50	100

	(m) 31st Aug., 1917.		(n) 12th Sept., 1917.	
A. vulgaris ...	82	82	35	70
A. discoides ...	0	0	0	0
A. mitrata ...	1	1	4	8
A. artocrea ...	17	17	11	22
Total ...	100	100	50	100

(o) 28th Sept., 1917.

	Actual No.	Percentage.
A. vulgaris ...	3	21·43
A. discoides ...	1	7·14
A. mitrata ...	3	21·43
A. artocrea ...	7	50·00
Total ...	14	100·00

Only 14 Arcellæ were counted on this occasion, consequently the percentage values are not so significant as in the preceding tables.

	(p) 2nd Nov., 1917.		(q) 30th Nov., 1917.	
	Actual No.	Percentage.	Actual No.	Percentage.
A. vulgaris ...	6	18·18	1	20
A. discoides ...	3	9·09	1	20
A. mitrata ...	15	45·45	2	40
A. artocrea ...	9	27·28	1	20
Total ...	33	100·00	5	100

In figs.1-4, the lines connecting the values of this date with those of 2nd November on the one hand, and 30th December on the other, are broken to indicate that little importance should be associated with them, as the total number actually counted is too small to convey much meaning. On this occasion, Arcellæ for counting were extremely rare.

(r) 29th Dec., 1917.

	Actual No.	Percentage.
A. vulgaris ...	26	52
A. discoides ...	5	10
A. mitrata ...	14	28
A. artocrea ...	5	10
Total ...	50	100

(2). *Locality*, Bribie Island. *Date*, early in April, 1915.

	Actual No.	Percentage.
A. vulgaris ...	23	60·53
A. mitrata ...	15	39·47
Total ...	38	100·00

TABLE i.

	29th Sept.	6th Oct.	30th Oct.	28th Nov.	28th Dec.	30th Jan.	28th Feb.	29th March.	2nd May.	31st May.	28th June.	1st Aug.	31st Aug.	12th Sept.	28th Sept.	2nd Nov.	30th Nov.	29th Dec.
A. vulgaris	2	0	0	0	72	84	37	67	71	77	41	62	82	70	22	18	20	52
A. discoides	8	0	2	86	5	0	1	2	4	5	0	6	0	0	7	9	20	28
A. mitrata	5	16	40	14	19	13	8	19	19	10	42	16	1	8	21	46	40	10
A. artocrea	85	84	58	0	4	3	54	12	6	8	17	16	17	22	50	27	20	10
Totals	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

The seasonal distribution of the four species in percentages. Brisbane Botanical Gardens; 29th Sept., 1916-29th Dec., 1917.

(3). *Locality*, Beerburrum. *Date*, 29th June, 1917.
Two living Arcellæ observed, both *A. vulgaris*.

(4). *Locality*, Chelmer. *Date*, 29th Aug., 1917.
Eight living Arcellæ observed, all *A. vulgaris*.

(5). *Locality*, Graceville. *Date*, 29th Aug., 1917.
Twenty-three living Arcellæ observed, all *A. vulgaris*.

(6). *Locality*, Cooroy. *Date*, 6th Oct., 1917.
Fifty living Arcellæ observed, all *A. artocrea*.

(7). *Locality*, West Burleigh. *Date*, October, 1917.
Twenty-three living Arcellæ observed, all *A. artocrea*.

(8). *Locality*, Maryborough. *Date*, 24th Nov., 1917.
Twenty-two living Arcellæ counted, all *A. vulgaris*.

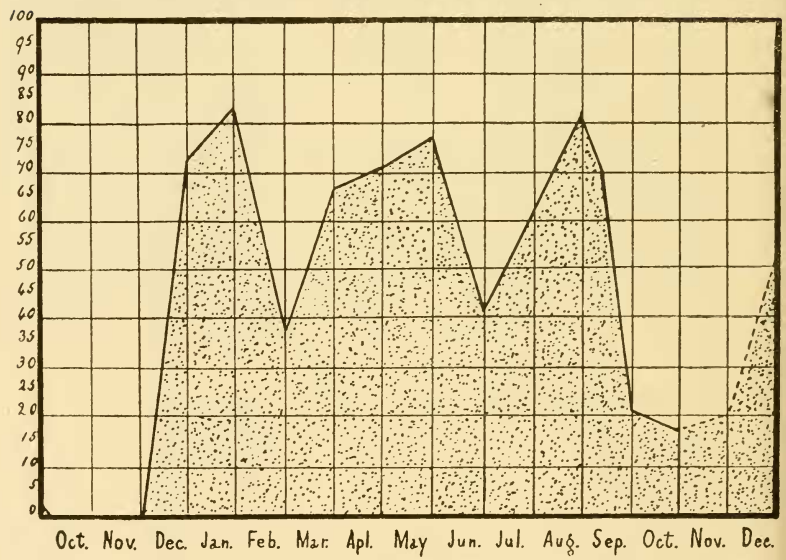

Fig. 1.—Percentage-frequency of *Arcella vulgaris* in Arcellan fauna. Brisbane Botanical Gardens: Sept. 29th, 1916, to Dec. 29th, 1917.

(3.) Conclusions.

Figs. 1-4 are graphical representations of the data given in Table i., and each species is graphed separately. It will be seen that the polygons are constructed on percentages. In taking

the observations, when the Arcellæ were sufficiently abundant, 100 counts were made; but, on a number of occasions, this was not done through the scarcity of the genus, the extreme case being in connection with the gathering of 30th November, 1917, when only five counts were recorded.

Fig.1, *A. vulgaris.* The graph shows two primary minimum periods (29th Sept.-28th Nov., 1916, and 28th Sept.-?Nov., 1917), and a long maximum period (28th Dec., 1916-12th Sept., 1917) with three secondary maxima (30th Jan., 31st May, 31st Aug., 1917), and two secondary minima (28th Feb. and 28th June, 1917). The highest point of the curve is 84% (28th Jan., 1917), and the lowest zero (6th Oct., 30th Oct., 28th Nov., 1916).

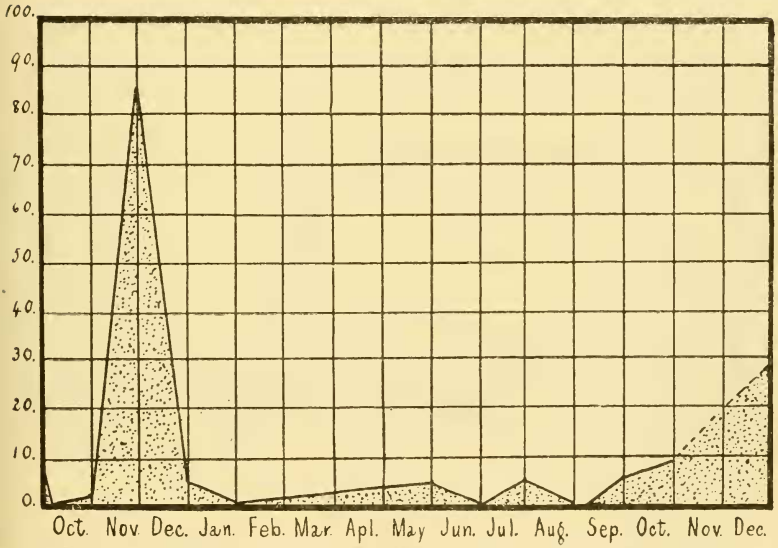

Fig.2.—Percentage-frequency of *A. discoides* in Arcellan fauna. Brisbane Botanical Gardens: Sept. 29th, 1916, to Dec. 29th, 1917.

It seems probable that the primary maximum and minimum periods are typical for the species in Southern Queensland, because, in the occasional material collected in the maximum period Dec.-Sept., the dominant form is *A. vulgaris* (*see* Bribie

Island, Chelmer, Graceville, Beerburrum, and Maryborough).* Furthermore, material gathered during the minimum period Sept.-Dec., shows a different dominant form (*see* Cooroy and West Burleigh). A feature of considerable importance in this connection is, that the most southerly and the most northerly locality are about 190 miles apart, viz., West Burleigh and Maryborough

Fig.2, *A. discoides*. The values in this graph are mostly small, and, out of eighteen observations, eleven range from 0·5% (6th Oct., 30th Oct., 28th Dec., 1916; 30th Jan., 28th Feb., 29th March, 2nd May, 31st May, 28th June, 31st Aug., 12th Sept., 1917). There is only one prominent maximum (86%, 28th Nov., 1916).

Until more data are collected in the case of this species, and of *A. mitrata*, it is considered premature to draw conclusions, though there is reason to believe November is a maximum period.

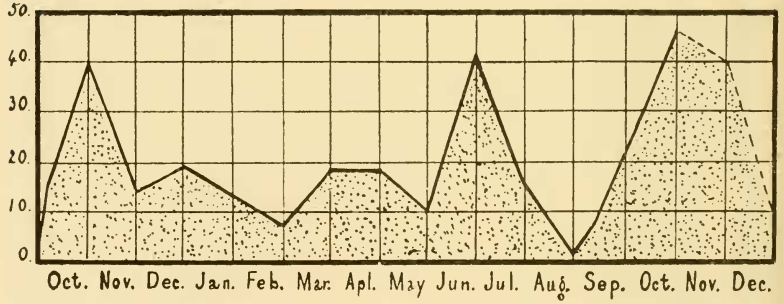

Fig.3.—Percentage-frequency of *A. mitrata* in Arcellan fauna. Brisbane Botanical Gardens: Sept. 29th, 1916, to Dec. 29th, 1917.

Fig.3, *A. mitrata*. Three maxima are present (30th Oct., 1916; 28th June, 2nd Nov., 1917) and of these, two (30th Oct., 1916, and 2nd Nov., 1917) occur during the maximum period of *A. vulgaris*. On only one occasion did the percentage fall below 5% (1% 31st Aug., 1917). It is the most consistent form of the

* 24th Nov. is sufficiently near December to be included in the maximum period.

four, as it occurs throughout the year, and its numerical range is the least (*see* Table ii.).

TABLE ii.

	Highest values.	Lowest values.	Range.
A. vulgaris	84% (30th Jan., 1917)	0%	84
A. discoides	86% (28th Nov., 1917)	0%	86
A. mitrata	46% (2nd Nov., 1917)	1%	45
A. artocrea	85% (29th Sept., 1916)	0%	85

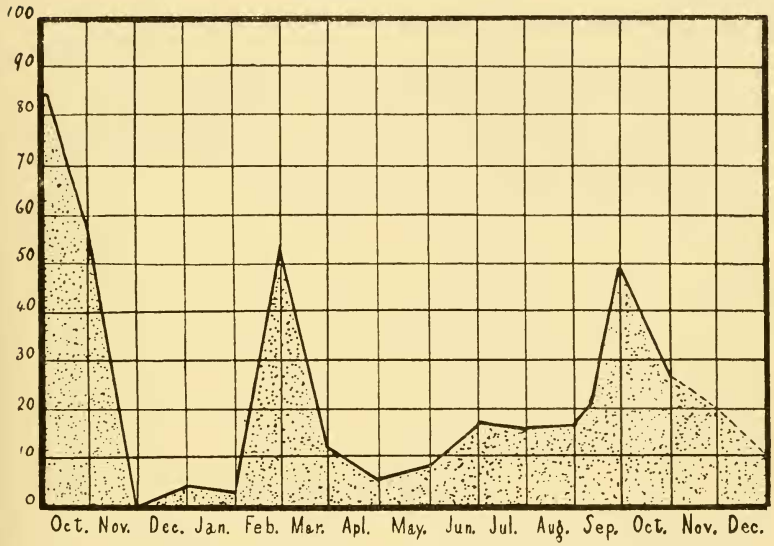

Fig. 4.—Percentage-frequency of *A. artocrea* in Arcellan fauna. Brisbane Botanical Gardens: Sept. 29th, 1916, to Dec. 29th, 1917.

Fig. 4, *A. artocrea*. Three maxima are present (29th Sept., 1916, 28th Feb., 28th Sept., 1917), the highest point of the curve being 85% (29th Sept., 1916), while the lowest is zero (28th Nov., 1916) The period September-October seems to be a dominant one for this form in Southern Queensland, as it includes two of the maxima, viz., 29th Sept., 1916, and 28th Sept., 1917; and in material from Cooroy and West Burleigh (*see* 6, 7) gath-

ered in October, 1917, the *only living Arcellæ* present were *A. artocrea*. Furthermore, the two localities are about 130 miles apart. Again in the occasional material collected outside the period September-October [*see* (2), (3), (4), (5), (8), the dominant form is *A. vulgaris*, not *A. artocrea*.

It is hoped by the collection of more data that deductions may be made in connection with *A. discoides* and *A. mitrata*, as well as in supplying confirmatory evidence in regard to *A. vulgaris* and *A. artocrea*.

BIBLIOGRAPHY.

1. Kofoid, C. A.—"The Plankton of the Illinois River, 1894-1899." Bull. Illinois State Lab. Nat. Hist., viii., Art. 1, 1908.
2. Leidy, J.—"The Freshwater Rhizopoda of N. America." 1879.
3. Wailes, G. H.—"Freshwater Rhizopoda and Heliozoa from the States of New York, New Jersey, and Georgia, U.S.A." Journ. Linn. Soc. Lond., Zool. xxxii., 1912, pp.121-161.